

1 **1. Introduction and Overview**

2 In the second office action Claims 1-3, 8-10, 12, 14 and 15 were rejected;  
3 the rejection was made final by Examiner. Claims 4, 7, and 13 were objected to.  
4 Claim 11 was allowed.

5 Claims 1-3, 8-10, 14 and 15 were rejected under 35 U.S.C. 103(a) over  
6 **Ramarathnam US Patent No. 6,316,895 B1** in view of **Joyner, Jr. et al US**  
7 **Patent No. 4,308,491**. Claim 12 was rejected under §103(a) as being  
8 unpatentable over **Ramarathnam** in view of **Slate et al US Patent No.**  
9 **4,919,596**. Claims 4, 7 and 13 were objected to as being dependent on a  
10 rejected base claim (Claim 1). **Ramarathnam** and **Joyner, Jr. et al** constitute  
11 new references cited by Examiner.

12 A brief summary of **Ramarathnam**, **Joyner, Jr. et al** and **Slate et al** is as  
13 follows:

14 **Ramarathnam** teaches a controller utilizing pulse width modulation  
15 (PWM) to generate a variable frequency and variable amplitude sinusoidal  
16 waveform used to vary the speed of an AC induction, reluctance or synchronous  
17 motor. In **Ramarathnam's** scheme the frequency of PWM is **not** the driving  
18 frequency of the motor as in the applicants' case, but is several times higher.  
19 **Ramarathnam's** PWM is used to generate a sine wave input to the motor  
20 wherein the higher the frequency of the PWM, the more accurately sinusoidal is  
21 the drive to the motor. Obtaining high sine wave fidelity is an explicit goal in  
22 **Ramarathnam**. The inventor explicitly states (pg.1 lines 29-32) that "... it is  
23 necessary to ensure that the output waveforms are as near to sinusoid as  
24 possible to minimize harmonic effects and reduce losses, noise and vibration. "  
25 (*Note: Ramarathnam's invention primarily addresses 3-phase induction motors*  
26 *for which a separate waveform is generated for each phase.*) In fact, one of the  
27 aims of **Ramarathnam's** invention (page 2 lines 64-66) is to "vary the magnitude  
28 and frequency of the applied voltage, while keeping the output waveform of the

1 inverter as close to sinusoidal as required." While the frequency of each of  
2 **Ramarathnam's** resultant sine waves is the driving frequency of the motor, the  
3 frequency of PWM used to generate the sine wave is not.

4 It is noted that **Ramarathnam** discloses that in addition to controlling AC  
5 motors his scheme is also applicable to brushless DC motors (col. 3, lines 36-  
6 37). This would only be possible if the DC motor is modified so that the AC signal  
7 is applied directly to the field windings. In this case the motor ceases to operate  
8 in the conventional DC mode and can no longer be called a "DC motor" even  
9 though specified as such in **Ramarathnam**.

10 **Joyner, Jr. et al** teach a pumping system wherein a plurality of pumps are  
11 driven by a plurality of variable speed AC motors controlled by a "control box".

12 **Slate et al.** teach a feedback controlled fluid delivery and control  
13 apparatus incorporating DC motors and a piston pump embedded into a  
14 disposable output cassette for accurately delivering fluid to a patient. **Slate et al**  
15 do not teach a "fountain system."

16 Before addressing the specific reasons for rejection in the office action, it  
17 is first necessary to address the issue of permanent magnet synchronous AC  
18 motors as addressed by Examiner in the second office action, Section 1, page 2.

19  
20 **2. Regarding Permanent Magnet Synchronous AC Motors (OA**  
21 **Section 1)**

22 It is noted that in applicants' original disclosure and thereafter in  
23 Amendment A and in the current amendment, applicants have limited Claim 1  
24 and 3 and amended claims 1 and 3 to AC permanent magnet synchronous motor  
25 pumps. The motor portion of these pumps is structurally different and internally  
26 functions differently than other AC synchronous motors not having permanent  
27 magnet rotors.

1 Examiner states (OA section 1 page 2) that "... all synchronous AC motors  
2 or synchronous DC brushless motors have permanent magnet rotors." No  
3 authority is given for this statement. If this statement were true, then in original  
4 Claim 1 and Claim 2 and in currently amended Claim 1 and amended Claim 3,  
5 applicants' limiting the motor pump to permanent magnet rotors would be moot -  
6 e.g. specifying "permanent magnet" would be just as meaningfully limiting as  
7 specifying the color that the motor housing is painted.

8 The above-cited statement of Examiner is not correct in two respects:  
9

#### 10 **2-A. DC Motors**

11 The term "synchronous DC brushless motors" has no meaning.  
12 A DC motor by definition cannot be synchronous, as there is no component  
13 within a pure DC supply to which the motor can synchronize. Applicants made a  
14 similar argument in Amendment A to counter Examiner's contention that  
15 applicants' motor was a brushless synchronous DC motor. It is however possible  
16 to drive many types of brushless DC motors as AC motors by bypassing the  
17 internal electronic commutation mechanism, in which case the motor effectively  
18 becomes an AC motor. When driven as such from an AC source, the motor can  
19 no longer be considered to be a DC motor. The specific reference to DC  
20 brushless motors in Ramarathnam's disclosure requires that the above  
21 modification be made in order for **Ramarathnam's AC** drive to function.  
22

#### 23 **2-B. AC Motors**

24 There are a number of examples of brushless AC synchronous  
25 motors that do **not** have permanent magnet rotors and these are well know art.  
26 One type is the very common reluctance-type synchronous motor. Motors of this  
27 type typically have "non excited" iron rotors with specific shapes designed to  
28 channel the induced magnetism into paths which synchronize the rotor to the

1 rotating field produced by stationary field coils. There are also types with a  
2 construction similar to "squirrel cage" induction motors but with certain sections  
3 of the cage removed to achieve fixed magnetic polarization of the rotor at normal  
4 running speeds.

5 Another form of brushless AC synchronous motor without a  
6 permanent magnet rotor is the hysteresis motor. In this type of motor the rotor is  
7 typically a smooth hard steel cylinder with high magnetic retentivity. In operation,  
8 the field coils induce a magnetic field into the rotor. This field will tend to remain  
9 static with respect to the rotor at low torque. These types of motors are common  
10 in clock drives. All three of the above types of motors are generally small and  
11 are used only in low torque applications.

12 Additionally, there is a class of brushless AC synchronous motors  
13 not having permanent magnet rotors that is typically used in large-scale  
14 applications such as in ship propulsion pods. In these motors the magnetic  
15 polarizing energy for the rotor is developed by AC generator windings attached to  
16 the main motor shaft which rotate within a static magnetic field generated by an  
17 external excitation current. The AC current from these rotating generator coils is  
18 rectified within the rotor assembly and fed to windings embedded in the main  
19 rotor to provide the fixed magnetic polarization for the rotor.

20 There are many variations of these types of motors, none having  
21 permanent magnet rotors, as well as other types which either by magnetic  
22 induction or by other means produce magnetic fields in the rotating part of the  
23 motor without the use of brushes or other forms of electrical (as distinct from  
24 magnetic or optical) contact with the rotor.

## 25 26 **2-C. Applicants' AC Synchronous Motor Pump**

27 The term "motor pump" has been used throughout applicants' disclosure  
28 (see, for instance applicants' disclosure pg. 3, lines 7-11) as has the term PMSM

1 pump (see, for instance applicants' disclosure pg. 8, lines 8-11) to refer to a  
2 pump comprised of an AC permanent magnet synchronous motor having an  
3 internal magnetic rotor and coupled impeller (see applicants' disclosure, pg. 4,  
4 lines 27-28 through pg. 5, lines 1-2). Applicants' AC PMSM pump is an integral  
5 unit. Limiting the motor pump to an AC permanent magnet synchronous motor  
6 pump in Claim 1 and Claim 3 and amended Claim 1 and amended Claim 3  
7 distinguishes from the general class of AC synchronous motors without  
8 permanent magnet rotors that are used to drive **physically separate** pumps.  
9 Many of these motors without permanent magnet rotors are multi-horsepower,  
10 many are three-phase and the majority are rigidly shaft-coupled to high flow rate  
11 pumps. (Note that some of these have flexible - rather than fixed - couplings to  
12 obviate shaft mis-alignment).

13 Permanent magnet synchronous motor pumps on the other hand are  
14 designed to be submersible and are generally fractional horsepower, have low  
15 flow rates (typically less than 2000 gallons- per- hour) and are designed for a  
16 100% duty cycle. These integral motor-pump units are used extensively in  
17 aquarium and small fountain applications since by design the rotor and the  
18 impeller are immersed in a common liquid (e.g. water). (Note that "sump pumps",  
19 which typically do not have permanent magnet rotors, do not have this feature  
20 and generally are designed for intermittent duty).

21 Advantageously, for AC PMSM pumps, liquid immersion prevents the rotor  
22 bearing system from overheating. Further, to avoid startup problems, these motor  
23 pumps generally allow the rotor and impeller to rotate between fixed stops  
24 relative to each other. Significantly, the rotor and impeller are normally **not** rigidly  
25 fixed to one another. These distinctions are important to applicants' arguments  
26 for allowance to follow.

27

28

1 **3. R j ction of Claim 1 under §103(a) ov r Ramarathnam in view of Joyner,**  
2 **Jr. et al is overcome**

3 Applicants have amended Claim 1 to more clearly annunciate the novel  
4 and non-obvious features over **Ramarathnam** in view of **Joyner, Jr. et al** and to  
5 further distinguish over the prior art.

6 In Claim 1 and Claim 1 amended, applicants specify an AC permanent  
7 magnet synchronous **motor pump** (emphasis added). It is clear from this  
8 description that the magnetic rotor and impeller **are part of the integral motor**  
9 **pump**. This would obviate a permanent magnet synchronous motor, for example,  
10 which is coupled via a shaft to a separate pump which in turn includes an  
11 impeller. The language of Claim 1 and amended Claim 1 clearly annunciates this  
12 point. In no place in applicants' disclosure is there mention of a separate motor  
13 and pump. In Examiner's rejection of Claim 1, Examiner states that "it would  
14 have been obvious ... to use Ramarathnam's motor to run Joyner's pump to  
15 achieve the same subject matter as claimed." Since Claim 1 and amended  
16 Claim 1 specify the control of a motor pump which is both structurally and  
17 functionally integrally combined, and **Joyner, et al** teach a plurality of separate  
18 pumps driven by a plurality of separate AC motors, the claimed feature of  
19 **Ramarathnam's** "motor" used in place of **Joyner's** motors to drive **Joyner's**  
20 pumps is lacking in Claim 1 and amended Claim 1. Further, **Ramarathnam** and  
21 **Joyner, et al** are individually complete and functional within themselves.

22 **Ramarathnam** discloses a controller for generating sinusoidal waveforms to  
23 drive an AC motor. **Joyner, et al** discloses a pumping system comprised of  
24 variable speed AC motors and separate pumps controlled with a "control box".  
25 There would be no reason to substitute **Ramarathnam's** motor controller for  
26 **Joyner's** "control box" to vary the speed of **Joyner, et al's** motors unless the  
27 suggestion came from applicants' own disclosure viewed in hindsight. Finally,

1 **Ramarathnam** does not teach a motor - he teaches a motor controller. These  
2 arguments argue against §103(a) rejection.

3 It is appropriate to spell out the major differences between applicant's  
4 amended Claim 1 and the teaching of **Ramarathnam**.

5 **Ramarathnam** describes a method of generating sine waves using cyclic  
6 PWM to drive an AC motor. In **Ramarathnam's** disclosure, the motor driving  
7 frequency is the sine wave frequency and **not** the PWM frequency. This is an  
8 important distinction between applicant's disclosure and amended Claim 1 (see  
9 **Ramarathnam** Fig. 4) and **Ramarathnam's** teaching.

10 In **Ramarathnam** the motor is driven by a waveform produced by a  
11 PWM waveform of much higher frequency than the driving frequency. This PWM  
12 frequency is typically at least 4x to 5x and more likely an order of magnitude or  
13 more higher than the driving frequency. The waveform in **Ramarathnam** is  
14 specifically tailored to produce with reasonable accuracy an AC sine wave of the  
15 type for which the motor was specifically designed, e.g. an AC sine wave such as  
16 is supplied with a common AC power line supply. Such an approach of  
17 generating sinusoidal waveforms using cyclic PWM is common practice.  
18 Importantly, it is noted that even for a given motor speed, the frequency of the  
19 PWM in **Ramarathnam** is not of necessity related to the output frequency sine  
20 wave or to motor speed. That is: In **Ramarathnam's** case the PWM frequency is  
21 clearly not linked harmonically to motor speed whereas the sine wave that the  
22 PWM generates is harmonically related.

23 In applicants' disclosure and in amended Claim 1 the motor driving  
24 frequency is the PWM frequency which is the synchronizing mechanism and is  
25 therefore directly related to the motor pump speed. Note that in applicants'  
26 disclosure (page 9, lines 21-24) the frequency, *f*, which is specified, is the  
27 frequency of the output pulse waveform driving the motor pump. For a  
28 synchronous AC motor, the speed of the motor **must** be in synchronization with

1 this frequency (see **Walker** technical definition quoted below). It is well known in  
2 AC motor art that a synchronous motor synchronizes to the predominant, lower  
3 frequency component (this is the driving component) of the applied waveform. In  
4 **Ramarathnam** this is the sine wave component of the multi-component  
5 waveform. In the applicants' amended Claim 1 it is clear that there exists only  
6 one predominant frequency component which is the driving component. The AC  
7 pulse switching signals of amended Claim 1 are not a sine wave and amended  
8 Claim 1 neither explicitly or implicitly describes the generation of such a  
9 waveform as taught in **Ramarathnam**.

10 The following definitions of *synchronous motor* and *synchronous machine*  
11 are in order: In Walker, P., Ed (1988) Chambers Science and Technology  
12 Dictionary. Chambers/Cambridge. New York. pg. 878, a synchronous motor is  
13 defined as an "A.c. electric motor designed to run in synchronism with supply  
14 voltage." Such motors retain synchronization with the **frequency** of the voltage  
15 applied to the motor. Further, a synchronous machine is defined in Walker as "  
16 An a.c. machine which rotates at a constant speed which is harmonically related  
17 to the frequency of the supply to which it is connected. If the machine is two pole,  
18 it will rotate at the supply frequency: if 4 pole, at half supply frequency, and so  
19 on." (pg. 878). In other words, the harmonic relationship is solely related to  
20 driving frequency and to the physical characteristics of the motor (i.e. the number  
21 of poles).

22 In applicants' disclosure a specific aim of the invention was to vary the  
23 flow rate of an AC PMSM pump by varying the frequency input to (driving) the  
24 motor pump and by correspondingly varying the pulse width such that the motor  
25 pumps power requirements are met over the widest range of motor pump  
26 **speeds** realizable (see applicants' disclosure pg. 3, lines 7-11, emphasis added).

27 Amended Claim 1 spells out these distinctions explicitly with the following  
28 language: " .... *varying the flow rate of said motor pump over an extended range*



1 *of flow rates in accordance with AC pulse switching signals applied to said motor*  
2 *pump further comprising means setting the frequency of said AC pulse switching*  
3 *signals for obtaining a given speed of said motor pump, wherein said speed is*  
4 *synchronous to said frequency for all realizable speeds of said motor*  
5 *pump...."* (emphasis added, see above pg. 13, lines 23 – 28, pg.14, line 1).

6 It is noted that amended Claim 1 patentably distinguishes from the pulse width  
7 modulation used by **Ramarathnam** to generate a sinusoidal waveform.

8 Further, amended Claim 1 specifies means of setting the pulse width in  
9 relation to the driving frequency with the following language: "... further  
10 *comprising means setting the pulse width of said AC pulse switching signals in*  
11 *relation to said frequency for a given motor speed in order to maintain constant*  
12 *and continuous flow for any given realizable speed of said motor pump...."*

13 In **Ramarathnam** the PWM changes cyclically with the motor revolution.

14 (e.g. the pulse width is proportional to the amplitude of the relevant part of the  
15 generated sine wave at any given moment in time) for any given fixed motor  
16 speed. In applicants' disclosure and amended Claim 1 the pulse width remains  
17 constant for a given fixed motor speed and pulse width changes (e.g.  
18 modulation) only occur as the intended motor speed changes.

19 The above distinctions, enunciated in amended Claim 1 strongly  
20 distinguish over **Ramarathnam** and the prior art.

21 Amended Claim 1 eliminates a major element of **Ramarathnam** - that is  
22 the computationally intensive generation of the higher frequency PWM waveform  
23 used to produce the lower driving frequency sinusoidal waveform required to  
24 synchronously drive the motor. Applicants' simplification - only AC pulse  
25 switching signals at the synchronous driving frequency are generated - makes it  
26 possible to control the AC PMSM pump of Claim 1 over a wide speed range  
27 while greatly reducing controller processor requirements. This simplification is  
28 important in terms of economic considerations and is a compelling argument in

1 overcoming potential **§103(a)** rejection of amended Claim 1. Novelly, because  
2 this simplification reduces computational demands on the microprocessor of  
3 amended Claim 1, applicants' processor program cycles at a considerably lower  
4 rate (therefore resulting in a much lower task overhead) for a given processor  
5 (micro controller) type and speed. Consequently more time is available for the  
6 processor to complete other tasks (e.g. A to D conversion, control program  
7 sequence, user input, external control code decoding etc.). This obviates having  
8 to rely upon a more powerful or second processor to perform such work.

9 Applicants' invention enunciated in amended Claim 1 also constitutes an  
10 unsuggested modification to the invention of **Ramarathnam**. In fact,  
11 **Ramarathnam** teaches in the other direction - that is - arguing toward obtaining  
12 higher sine wave fidelity balanced by processor constraints. This is another  
13 argument in overcoming potential **§103(a)** rejection.

14 Applicants' invention as enunciated in amended Claim 1 is also contrary to  
15 the teaching of the prior art and is a strong argument against potential **§103(a)**  
16 rejection. For example, it is natural to assume that since AC motors are  
17 designed to run on a sinusoidal waveform from the AC line, one should attempt  
18 to reproduce that waveform as closely as possible in any mechanism designed to  
19 effect a speed change by changing frequency. That is exactly what  
20 **Ramarathnam's** invention spells out. (See Amendment B, section 1 and  
21 **Ramarathnam** page 1 lines 29-32). In contrast, applicant's invention and  
22 amended Claim 1 specify a much simpler approach by driving the motor pump  
23 directly and in synchronism with the AC pulse switching signal frequency for all  
24 realizable speeds of the motor pump. Novelly, this approach significantly reduces  
25 computation-time overhead.

26 The invention has been implemented in hardware and software by  
27 applicants' and results in exceptional control of the AC PMSM pump of amended  
28 Claim 1. This could be viewed as an unexpected and surprising result -

1 especially in light of **Ramarathnam** - since applicants' pulse switching signals  
2 differ markedly from a sinusoidal waveform. Since **Ramarathnam** is primarily  
3 concerned with the control of large three-phase induction motors where the  
4 sinusoidal waveform issue is more relevant, the approach in **Ramarathnam**  
5 would be substantial overkill if used to control the low torque, low power AC  
6 PMSM pumps of applicants' invention. This is yet another argument against  
7 potential **§103(a)** rejection of Claim 1.

8 Novelly, applicants' **combination** of motor driving supply frequency  
9 control **and** Pulse Width Modulation control is used to considerably extend the  
10 working speed range over which an AC synchronous motor pump can be usefully  
11 varied in an economically cost effective manner. The invention is thus novelly  
12 and perfectly suited to control low cost, low flow rate AC PMSM pumps.  
13 Applicants submit that amended Claim 1 defines patentably over **Ramarathnam**  
14 and the prior art and is now in a condition for allowance.

15  
16 **4. Rejection of Claim 3 under §103(a) over Ramarathnam in view of**  
17 **Joyner, Jr. et al is overcome**

18 Applicants have amended dependent Claim 3 incorporating the AC  
19 permanent magnet synchronous motor pump of cancelled Claim 2 with further  
20 limitation. Amended Claim 3 specifically limits to AC permanent magnet  
21 synchronous motor (PMSM) pumps wherein both rotor and impeller are  
22 immersed in a common liquid. This type of pump is normally submersible,  
23 however such pumps can be operated outside of a liquid environment by  
24 providing suitable liquid-tight couplings for inlet and outlet liquid. In this type of  
25 pump the motor and the pump form an integral unit. This is referred to in  
26 applicants' disclosure as a "motor pump". These motor pumps are typically  
27 fractional horsepower and, as pointed out in applicant's disclosure, are generally  
28 used in fountain applications.

1 In rejecting Claim 2 based on §103(a), Examiner states that  
2 **Ramarathnam's** motor is an AC permanent magnet synchronous motor which  
3 can be used to run **Joyner's** pump to output a flow of liquid. Applicants will  
4 respond to this statement since cancelled Claim 2 with further limitation has been  
5 incorporated into amended Claim 3. **Ramarathnam** teaches a motor controller -  
6 not a motor. **Joyner** teaches a pumping system where a plurality of variable  
7 speed AC motors and a plurality of separate pumps are controlled by electronics  
8 in an associated "control box". Each of these references cited by Examiner is  
9 complete within itself. While **Ramarathnam's** motor controller could conceivably  
10 be used to control each of **Joyner's** motors, such combination could only be  
11 made in hindsight in view of the applicants' own disclosure. Further, use of  
12 **Ramarathnam's** controller to replace **Joyner's** control box and external circuitry  
13 (see **Joyner, et al** Fig. 2) would require substantial and not necessarily  
14 straightforward modifications for such use to be operative. Additionally, amended  
15 Claim 3 comprises an **integral** motor pump - not separate motors and pumps as  
16 in **Joyner**. Finally, applicants note that even if **Ramarathnam** taught an AC  
17 PMSM, combining such a motor to replace each of **Joyner's** motors would not  
18 meet the subject matter of amended Claim 3.

19 Applicants will now address the rotor/impeller issues explicit in Examiner's  
20 rejection of Claim 3. In rejecting original Claim 3, Examiner notes that for  
21 "motor/pump systems", the method of connecting the rotor shaft to the impeller  
22 shaft is with a rigid screw-coupling. Examiner is clearly viewing such a system as  
23 having a separate motor driving a separate pump. Examiner also states that an  
24 impeller, rotor and coupling are all prior art. For pumping systems where the  
25 pump and the motor are separate units, this assessment is generally accurate  
26 subject to the provisos of Section 2-C above.

27 However, for the AC PMSM pumps of amended Claim 3, wherein the rotor  
28 and impeller are an integral unit which is immersed in a common liquid, fixing the

1 rotor and impeller so that they cannot rotate with respect to each other is not  
2 normal or common practice. Rather, the common and normal practice is to allow  
3 the impeller to have a limited degree of free rotation in both directions with  
4 respect to the rotor. [see for example **Cabalcante (US4247265)**, **Ellis, et al (US**  
5 **5282961)** and **Willinger and Ivasauskas (US4861468)**]. A common example of  
6 an AC PMSM submersible motor pump in wide U.S. distribution with this type of  
7 rotor/impeller coupling is the Rio® Aqua Pump 200 distributed in the U.S. by  
8 T.A.A.M., Inc., Camarillo, California. Without the limited-free-rotation of the rotor  
9 and impeller, pumps of this type will not reliably start upon being energized with a  
10 sinusoidal voltage from the AC line. This is due in part to the resistive force on  
11 the impeller due to the static water head and due to the typically low startup  
12 torque of such motor pumps. In these motor pumps, by allowing a limited degree  
13 of free rotation of the impeller with respect to the rotor, the rotor is allowed to  
14 begin rotation without the resistance of the impeller. Also, due to the smooth  
15 sinusoidal nature of the AC source, rotor/impeller chatter is eliminated when  
16 these motor pumps are driven at their design frequency from the AC line.

17 Amended Claim 3 teaches away from the above accepted practice of  
18 limited-free-rotation of rotor and impeller in the prior art for such motor pumps,  
19 which in itself is a compelling argument against a **§103(a)** rejection.

20 Regarding amended Claim 3, if the controller of amended Claim 1 upon  
21 which Claim 3 depends, were coupled with the limited-free-rotation rotor/impeller  
22 of the prior art described above, objectionable impeller chatter would result  
23 especially in the lower range of realizable pump speeds. This would be  
24 exacerbated by the pulse nature of the switching signals of amended Claim 1  
25 (which are not sinusoidal), back pressure from the water head and the non-  
26 directional preference of the motor pump.

27 Regarding **§102(b)** novelty, rotor chatter is effectively eliminated with the  
28 fixed rotor/impeller of amended Claim 3 when coupled with the controller of

1 amended Claim 1. This allows the motor pump to function smoothly over the  
2 realizable range of motor pump speeds and associated pump flow rates. Also  
3 novelly, the controller of amended Claim 1 and the fixed rotor and impeller of  
4 amended Claim 3 result in reliable motor pump startup which is not the case if  
5 the motor pump is driven directly from the sinusoidal AC line and the rotor and  
6 impeller is fixed to prevent relative rotation. The reliable starting behavior of  
7 motor pumps of Claim 3 is a demonstrable consequence of driving the motor  
8 pump with a pulse waveform of the type generated by the controller of amended  
9 Claim 1.

10  
11 **5. Rejection of Claim 8 under §103(a) over Ramarathnam in view of**  
12 **Joyner, Jr. et al is overcome**

13 Claim 8 has been amended to specifically interface a DMX control signal  
14 to the controller. Applicants' disclosure (pg. 8, lines 18-21) references a DMX  
15 signal to set the instantaneous desired pump flow rate. A single DMX controller  
16 can be used to independently control up to 512 separate motor pumps based on  
17 a complex set of pre-programmed external events. Such DMX controllers are  
18 used extensively to control multi-media and stage presentations. Claim 8 is novel  
19 in that it allows a motor pump to be interfaced to a complex pre-programmed  
20 external system. It would be a strained interpretation to rely on the "read set  
21 speed" step in **Ramarathnam's Fig. 9** to base a potential §103(a) rejection of  
22 amended Claim 8. The "read set speed" step in **Ramarathnam's Fig. 9** simply  
23 sets the speed from the operator console or keypad (pg. 9, lines 24-25).

24  
25 **6. Rejection of Claim 10 under §103(a) over Ramarathnam in view of**  
26 **Joyner, Jr. et al is overcome**

27 Claim 10 has been amended to enunciate the patentable features of the  
28 software program disclosed in applicants' Fig. 3 and described in applicants'

1 disclosure. Amended Claim 10 distinguishes over **Ramarathnam** and over the  
2 prior art. Specifically, the program of amended Claim 10 computes AC pulse  
3 switching signals "*... as required to synchronously drive said motor pump at the*  
4 *frequency of said AC pulse switching signals and with said AC pulse switching*  
5 *signals having a pulse width as required to maintain synchronization of said*  
6 *motor pump with said AC pulse switching signals over all realizable speeds.*"

7 This language distinguishes over **Ramarathnam** and over the prior art.

8 Specifically, the flow chart in **Ramarathnam's** Fig. 9 computes a sine wave  
9 generated by a PWM frequency considerably higher than the motor driving  
10 frequency. It would be a strained interpretation of "program" to describe  
11 **Ramarathnam's** program with amended Claim 10. While the program in  
12 amended Claim 10 and in **Ramarathnam** both affect a change in motor speed,  
13 they do so in substantially and patentably distinguishable ways. This distinction is  
14 clearly made in amended Claim 10.

15  
16 **7. Rejection of Claim 12 under §103(a) over Ramarathnam in view of**  
17 **Slate et al is overcome**

18 Claim 12 originally depended on Claim 2 (now cancelled). Claim 12 has  
19 been amended to depend on amended Claim 3 which incorporates the subject  
20 matter of cancelled Claim 2 with further limitation. Amended Claim 3 depends on  
21 amended Claim 1.

22 Regarding §103(a) rejection of Claim 12, Examiner states that  
23 **Ramarathnam** does not teach a fountain system but **Slate et al** does. Because  
24 **Slate et al** requires a motor driver, Examiner contends that "it would have been  
25 obvious to a skilled person to use Ramarathnam's motor to run the fountain  
26 system of Slate to achieve the same subject matter."

27 **Slate, et al** does not teach a fountain system. **Slate et al** teach an  
28 intermittently driven piston pump coupled to separate DC motors and used to

1 feed a fluid cassette in a patient fluid delivery system. This system would be  
2 wholly inappropriate to drive a fountain as enunciated in Claim 12 or for that  
3 matter any fountain designed for generating variable output flow patterns.  
4 Moreover, **Slate et al** specify a feedback controller which cannot cause a  
5 variation in output of an AC PMSM pump as in Claim 12.

6 **Ramarathnam** teaches a motor controller - not a motor. **Ramarathnam's**  
7 motor controller is designed to control an AC motor - not a DC motor as  
8 disclosed in **Slate et al**. (See earlier argument {Section 2-A} regarding DC  
9 motors driven as AC motors.)

10 Combining the AC control of **Ramarathnam** to replace the motor driver in  
11 **Slate et al** would result in an in-operative combination: **Ramarathnam's** AC  
12 control would not control the **Slate et al** DC motors without the atypical  
13 modifications required to turn the **Slate et al** motors into AC motors. One could  
14 also argue that it would be impossible to combine the two cited references to any  
15 practical effect.

16 Furthermore, each of the references cited by Examiner is complete within  
17 itself. There is no reason to combine the two references - especially in light of  
18 the above arguments. These are strong arguments against a **§103(a)** rejection.

19 Novelly, the fountain of amended Claim 12 attains an exquisite degree of  
20 control with only one moving part - the rotor in the AC PMSM pump! Using the  
21 sine wave control of **Ramarathnam**, although not suggested by Examiner, would  
22 result in substantial processor overkill and associated increased cost to control  
23 what is essentially a low cost submersible pump. Beyond this argument,  
24 amended Claim 12 results in a substantial improvement in implementation, cost  
25 and fountain maintainability over the commonly accepted dynamic fountain art of  
26 utilizing motor, pump, controller, electrically actuated valves, holding tanks and  
27 plumbing to perform the same task.

28



1           **8. Objection of Claims 4, 7 and 13 as being dependent on a rejected**  
2                                   **base claim is overcome**

3           Examiner rejected Claims 4, 7 and 13 as being dependent on a rejected  
4           base claim (Claim 1). Claim 1 has been amended and based on applicants'  
5           arguments, applicants submit that amended Claim 1 is clearly allowable over the  
6           prior art. Applicants' respectfully request that Claims 4, 7, and 13 be granted as  
7           objections to base Claim 1 have been addressed and overcome.

8  
9                                   **9. Request for Reconsideration**

10          Claim 1 was amended to further enunciate the unique features of the  
11          invention, to further distinguish from the prior art and to more specifically  
12          overcome §103(a) objections based on **Ramarathnam** and **Ramarathnam** in  
13          view of **Joyner, et al.**

14          Claim 3 was amended to include the subject matter of cancelled Claim 2  
15          with further limitation to liquid immersed rotor/impellers and to overcome §103(a)  
16          objections based on the prior art especially relative to coupling separate motors  
17          and pumps.

18          Claim 8 was amended to limit to DMX control and to overcome §103(a)  
19          rejection based on **Ramarathnam**.

20          Claim 10 has been amended to enunciate the patentable features of the  
21          software program and to overcome §103(a) objections over **Ramarathnam**.

22          Claim 12 was amended to depend on amended Claim 3 and to overcome  
23          §103(a) arguments based on **Ramarathnam** in view of **Slate et al.**


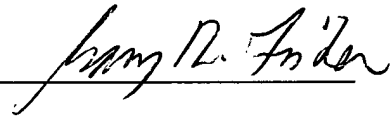
24          Dependent Claim 4, 7 and 13 depend on amended Claim 1 for which  
25          §103(a) arguments have been addressed and overcome. Applicants submit that  
26          Claims 4, 7 and 13 are now in condition for allowance.

**10. Conclusions and Request for Constructive Assistance**

Based on all the arguments forwarded by the applicants to counter Examiner objections and based upon changes to the claims to more clearly enunciate the novel and patentable features of the invention, the applicants submit that amended Claims 1, 3, 8, 10 and 12 all define patentably over the prior art and are clearly allowable. Applicants also submit that Claims 4, 7 and 13 be granted as the basis for rejection has been corrected. Therefore applicants submit that this application is now in condition for allowance, which action they respectfully solicit.

If for any reason this application is not believed to be in full condition for allowance, applicants respectfully request the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. §21783.02 and §707.07(j) in order that applicants can place this application in allowable condition as soon as possible and without the need for further proceedings.

Very Respectfully,

Chris S. Brunt  Gary R. Fisher   
Applicants Pro Se

Dated: 15 AUGUST 2003

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**C r t i f i c a t   o f   M a i l i n g**

I hereby certify that this correspondence and attachments, if any, will be deposited with the United States Postal Service by Express Mail # ET557029455US, postage prepaid, in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date below.

Date: 15 August 2003

Inventor's Signature:

Chris E. Brunt.